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Research Article

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Study on the influence of micro nutrients and growth regulator on the growth and yield of sesame (*Sesamum indicum* L.) and nutrient availability in coastal saline soil

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Summary

A pot experiment was conducted in the Department of Soil Science and Agricultural Chemistry, Annamalai University during Feb.-April, 2015. The initial characteristics of experimental soil revealed the saline nature having pH 8.02 and EC 4.26 dS m^{-1}. The available NPK status were low and DTPA extractable Zn and Mn were below the critical limit. The design of experiment was Completely Randomised Design and the treatments were: T_1 – NPK (35: 23: 23 kg N: P_2O_5: K_2O ha^{-1}), T_2 – NPK + $ZnSO_4$ @ 25 kg ha^{-1} + $MnSO_4$ @ 5 kg ha^{-1}, T_3 – T_2 + FYM @ 12.5 t ha^{-1}, T_4 – T_2 + vermicompost @ 4 t ha^{-1}, T_5 – T_2 + humic acid @ 20 kg ha^{-1}. Growth regulator sea weed extract was applied as 0.5 per cent foliar at vegetative and flowering stage for all the treatments except control. The treatments were replicated four times and sesame var TMV- 3 was grown as test crop. The results of the study revealed that among all the treatments, T_5, the application of recommended NPK +$ZnSO_4$ + $MnSO_4$ with humic acid application accounted for a significant increase in growth character, yield components and yield of sesame. This treatment also significantly improved the soil nutrient availability.

Key words : Sesame, INM, Growth, Yield, Coastal sandy soil

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Introduction

Sesame is one of the major oilseed crops in India, ranking after groundnut and mustard-rapeseed. Though, it is a major oilseed crop grown over larger area, its production is very low for the reasons, growing without much nutrient application especially micronutrients and organic manures. In India, coastal saline soil spread over an area of 3.1 m ha and the prevailing high salinity and pH restrict the availability of micronutrients (Bandyopadhyay *et al.,* 2001). Sesame is one of the important crop grown in coastal area. Zn and Mn are important micronutrients in sesame production. Reduced growth hormone production in Zn deficient plants causes shortening of internodes and short leaves resulting in malformation of fruit and low yield (Havlin *et al.*,2005). Mn is essential for photosynthetic reactions, enzyme

activation and root growth (Mortvedt *et al*., 1999). Plant growth regulators are known to change the growth and development pattern of crop plants by altering many physiological and biochemical processes and thereby increasing the yield of crops. Sea weed extract is a new generation natural organic fertilizer containing highly effective nutritious and growth promoting substances (Bentley, 1960 and Sekaran and Rengasamy, 2010). Hence, in this investigation an attempt was made to study the influence of organic manures, micronutrients and plant growth regulators on growth and yield of sesame and nutrient availability in soil.

Resource and Research Methods

A pot experiment was conducted in the Department of Soil Science and Agricultural Chemistry, Annamalai University during Feb-April, 2015. The initial characteristics of experimental soil revealed the saline nature having pH 8.09 and EC 4.06 dS m^{-1} and taxonomically classified as typic ustifluent. The available NPK status were low, low and medium, respectively. The DTPA extractable Zn was 0.90 mg kg^{-1} and Mn 1.73 mg kg^{-1}.The design of experiment was Completely Randomised Design and the treatments were: T_1 – NPK (35: 23: 23 kg N: P_2O_5: K_2O ha^{-1}), T_2 – NPK + $ZnSO_4$ @ 25 kg ha^{-1} + $MnSO_4$ @ 5 kg ha^{-1}, T_3 – T_2 + FYM @ 12.5 t ha^{-1} , T_4 – T_2 + vermicompost @ 4 t ha^{-1}, T_5 – T_2 + humic acid @ 20 kg ha^{-1}. Growth regulator sea weed extract was applied as 0.5 per cent foliar spray to treatments T_2 to T_5 excluding control. The number of replication was four and sesame var TMV 3 was grown upto maturity. Various growth and yield characters of sesame and at harvest stage pod and haulm yield were recorded. The post harvest soil sample were collected from each treatment and they were air dried, powdered, sieved through 2mm sieve and analysed for soil properties *viz.*, pH, EC, organic carbon and available major nutrients N,P and K and micro nutrients Zn and Mn using the standard procedure (Jackson, 1973).

Research Findings and Discussion

The data recorded on vegetative growth (Table 1) revealed the significant influence of organic manures, micronutrients along with growth regulator on the various growth characters. Among all the treatments, T_5, application of recommended NPK +$ZnSO_4$ + $MnSO_4$ with humic acid application accounted for a significant increase in plant height (85.3 cm), DMP (53.4 g per plant) and LAI (4.83). This was followed by treatment T_4 and T_3. Control recorded the significantly lowest growth

Table 1: Effect of micronutrients and plant growth regulator on the growth and yield of sesame (*Sesamum indicum* L.)

Treatments	Plant height (cm)	DMP (g/pot)	No. of pods/plant	Seed yield (g/pot)	Haulm yield (g/pot)
T_1	59.3	32.5	26.5	24.2	40.5
T_2	64.5	38.9	35.0	28.5	48.4
T_3	69.2	41.3	39.5	30.8	57.2
T_4	78.4	47.2	42.5	32.5	63.6
T_5	85.3	53.4	47.7	35.7	67.3
S.E.±	1.87	1.31	0.93	0.86	1.57
C.D. (P=0.05)	3.74	2.63	1.86	1.73	3.15

T_1 – NPK (35: 23: 23 kg N: P_2O_5: K_2O ha^{-1}), T_2 – NPK + $ZnSO_4$ @ 25 kg ha^{-1} + $MnSO_4$ @ 5 kg ha^{-1}, T_3 – T_2 + FYM @ 12.5 t ha^{-1} , T_4 – T_2 + vermicompost @ 4 t ha^{-1}, T_5 – T_2 + humic acid @ 20 kg ha^{-1}. Growth regulator sea weed extract @ 0.5 per cent foliar spray applied to treatments T_2 to T_5 excluding control.

Table 2: Effect of micronutrients and plant growth regulator on the pH, EC and soil nutrient availability (kg ha^{-1})

Treatments	pH	EC (dS m^{-1})	Organic C (%)	Avail. N	Avail. P	Avail K	DTPA-Zn	DTPA-Mn
T_1	8.01	3.79	0.39	62.2	4.5	97	0.83	1.70
T_2	7.98	3.62	0.42	65.3	4.7	101	0.95	1.80
T_3	7.70	2.97	0.52	71.4	5.1	106	1.03	1.87
T_4	7.64	2.92	0.59	75.3	5.3	110	1.07	1.94
T_5	7.60	2.74	0.68	79.6	5.9	116	1.13	1.99
S.E.±	0.09	0.02	0.02	1.87	0.05	1.62	0.01	0.01
C.D. (P=0.05)	0.19	0.04	0.05	3.75	0.11	3.25	0.03	0.02

character of sesame. The improved growth character with organics and micronutrients might be due to promoted growth and nutrient uptake of plants due to addition of humic substances (Chen and Aviad, 1990) and micronutrients (Sumangala, 2003).

The pods number significantly increased with the application of organic manure and micronutrients to a range of 35.0 - 47.7 as compared to 26.5 in control. A significantly higher seed (35.7 g pot^{-1}) and haulm (67.3 g pot^{-1}) yield accounting for 47.2 and 66.17 per cent increase in seed and haulm yield, respectively over control was recorded in treatment T_5. The increase in yield might be due to increased availability of nutrients with improvement in soil properties by way of reduced salinity and pH with this treatment. This result is in agreement with earlier report of Singaravel and Prasath (2004) and Meng *et al*. (2005). Applied humic acid by way of reducing the leaching and volatilization loss of N, chelation with phosphate ion and increased solubility and dissolution of K from soil minerals (Khan *et al*. 1984 and Chen and Aviad, 1990) might have increased the nutrient availability and enhanced the nutrient uptake resulting in improved growth and yield of sesame. The growth and yield enhancing potential of sea weed might be attributed to the effect due to presence of carbohydrates, phenyl acetic acid, vitamins and plant growth regulators (Taylor and Wilkinson, 1997) and macro and micronutrients (Sekaran and Rengasamy, 2010).

There was significant improvement in pH and EC of soil due to organic matter addition to soil as compared to control. The reduction of soil pH and EC could be ascribed due to production of organic acid upon decomposition of organic manures as concluded by earlier authors (Bhrguvanshi, 1988 and Meng *et al.*, 2005). A profound of influence various organic manures along with NPK fertilizers in increasing the soil available nutrients was clearly brought out in the present study. Though all the treatments were significant, the highest alkaline $KMNO_4$-N (79.6 mg kg^{-1}), Olsen-P (5.9 mg kg^{-1}) and NH_4OAC-K (116 mg kg^{-1}) were recorded with NPK+ humic acid+ $ZnSO_4$ + $MnSO_4$ (T_5). This corroborates the earlier report of Nazirkar and Kamthe (2012) and Singaravel and Prasath (2004).

The DTPA extractable Zn and Mn in soil significantly increased with NPK + Zn + Mn + organic manure application. The highest availability of DTPA-Zn and Mn was recorded in treatment T_5, application of recommended NPK +$ZnSO_4$ + $MnSO_4$ with humic acid followed by T_4 and T_3. With the addition of humic acid and organic manures, the microbial activity is enhanced which produced chelating agent and complexed micronutrient cat ions increased their availability. Further the higher availability might be due to sequestration of the added Zn and Mn with humic acid to form soluble organic complexes. In the absence of HA addition, the newly applied micronutrients would be rapidly transformed into insoluble form as reported by Chandrasekharan (1989).

Conclusion :

The results of the study indicated that the application of recommended dose of NPK fertilizer + $ZnSO_4$ @ 25 kg ha^{-1}+$MnSO_4$@ 5 kg ha^{-1}+humic acid@ 20 kg ha^{-1} and spraying of sea weed extract accounted for significant increase in growth and yield of sesame besides improving the nutrient availability in soil.

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